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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
KUNZER, BRIAN	

ART UNIT	PAPER NUMBER
2814	

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Please find below and/or attached an Office communication concerning this application or proceeding.

H·A

Office Action Summary	Application No.	Applicant(s)	
	10/517,819	LEE, SUK HUN	
	Examiner	Art Unit	
	Brian Kunzer	2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *13 October 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-39* is/are pending in the application.

4a) Of the above claim(s) *27-33* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-6,9-11,13-15,18-21,24-27,34,35,38 and 39* is/are rejected.

7)☒ Claim(s) *7,8,12,16,17,22,23,36 and 37* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☒ Certified copies of the priority documents have been received in Application No. 10/343,701.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *12/14/04*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

Applicant's election without traverse of claims 1-26 and 34-39 in the reply filed on October 13, 2005 is acknowledged.

Claim Objections

Claim 34 is objected to because of the following informalities: this claim recites the limitation "*a buffer layer* formed above the substrate" and then proceeds to add "a first electrode contact layer formed above *the GaN buffer layer.*" While the meaning of the recitation of the "the GaN buffer layer" is clear to the examiner, examiner requests that, for the sake of clarity, this mention of "the GaN buffer layer" be changed to "the buffer layer". Appropriate correction is required.

Claim Rejections - 35 USC § 112

Claim 12 and 15 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 12 recites the limitation "low mole In-doped $In_xGa_{1-x}N$" in "low mole In-doped $In_xGa_{1-x}N$ layer". There is insufficient antecedent basis for this limitation in the claim. The base claim 1 only mentions "a first In-doped GaN layer", " a second In-doped GaN layer", and "a $In_xGa_{1-x}N/In_yGa_{1-y}N$ super lattice structure layer." Examiner will assume the "low mole In-doped

$In_xGa_{1-x}N$" to be read as the "first In-doped GaN layer" in claim 12 for the purposes of examination.

Claim 15 recites the limitation " p-type" in "p-type GaN layer". There is insufficient antecedent basis for this limitation in the claim. The base claim 13 only mentions a "first In-doped GaN layer" and a "GaN layer." Examiner will assume the "p-type GaN" to be read as the "GaN layer" in claim 15 for the purposes of examination.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

1. Claims 1 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nagahama (US Patent No. 6,849,864) in view of Yamada (US Patent No. 6,608,330) and Emerson (US Patent No. 6,958,497).

With respect to claim 1, Nagahama teaches, from fig. 9 (and columns 34-40), a nitride based 3-5 group compound semiconductor light emitting device comprising:

a substrate (301);

a buffer layer (304) formed above the substrate (301);

a first In doped GaN layer (312) formed above the buffer layer (304);

a super lattice structure layer (313) formed above the first In-doped GaN layer (312);

a first electrode contact layer (311);

an active layer (315) formed above the first electrode contact layer (311) and functioning to emit light;

a second In doped GaN layer (317);

a GaN layer (319) formed above the second In-doped GaN layer (317); and

a second electrode contact layer (320) formed above the GaN layer (319).

Nagahama does not teach that the first electrode contact layer (311) is formed above the super lattice structure layer (313).

However, Yamada, drawn to group III-nitride light emitting diodes (LEDs), teaches, from fig. 1, a contact layer (111) above a super lattice cladding layer (105).

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of invention, to create the device of Nagahama including a super lattice structure underneath the first contact layer as described by Yamada because it is well known in the art that a super lattice structure (alternating layers of two different several nanometer thick semiconductor materials) encourages better crystal growth of any layers grown thereon, thereby achieving better overall performance and efficiency. Edmond, column 15, lines 1-15 of US Patent No. 6,906,352, is cited for this well known position.

Nagahama also does not teach that the super lattice structure (313) is specifically a $In_xGa_{1-x}N/In_yGa_{1-y}N$ super lattice structure layer.

However, Emerson, drawn to group III-nitride light emitting diodes (LEDs), teaches, from fig. 1, a $In_xGa_{1-x}N/In_yGa_{1-y}N$ super lattice structure layer (16) beneath the active region (18). (See column 7, lines 19-22.)

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of invention, to create the device of Nagahama including the super lattice structure of Emerson having alternating layers of $In_xGa_{1-x}N/In_yGa_{1-y}N$ instead of alternating layers of $Al_xGa_{1-x}N/GaN$ (as used by Nagahama) because either of these structures perform the same function of decreasing crystal defects in any group III-nitride grown thereon, thereby increasing device performance. Edmond, column 15, lines 1-15 of US Patent No. 6,906,352, is cited for this well known position.

Furthermore, examiner takes the position that the material selected for the super lattice structure, in view of those used in the prior art, is non-critical to the applicant's invention. Nagahama (with Yamada) discloses all the limitations of the claimed invention except for specifically teaching that the super lattice structure layer is, "an $In_xGa_{1-x}N/In_yGa_{1-y}N$ super lattice structure layer." It would have been obvious to one of ordinary skill in the art, at the time of invention, to replace the $Al_xGa_{1-x}N/GaN$ super lattice structure layer of Nagahama's device with one that is made of $In_xGa_{1-x}N/In_yGa_{1-y}N$ alternating layer (as disclosed above by Emerson), since it has been held to be within the general skill of a person in the art to select a known material on the basis of its suitability for the intended use (to enhance device crystal structure by reducing crystal defects) as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416. Note that Suzuki (US Patent No. 6,479,836), from column 11, lines 64-67 and Zheng (Non-patent document ref. [U]), from introduction, are cited for the non-criticality and well known use of this particular material structure.

With respect to claim 5, Emerson teaches the active layer comprises a single or multiple quantum well structure. (See column 10, lines 62-65.)

2. Claims 2 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nagahama (US Patent No. 6,849,864), Yamada (US Patent No. 6,608,330) and Emerson (US Patent No. 6,958,497) as applied to claim 1 above, and further in view of Lee (US Patent No. 6,720,570).

Nagahama, Emerson, and Yamada do not teach that the second electrode contact layer is an n-type electrode contact layer.

However, Lee, drawn to gallium nitride LEDs, does teach, from fig. 2, a second electrode contact layer (209) that is an n-type electrode contact layer. Additionally there is p-type layers, 205, 206, and 211, placed above the first n-type electrode.

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of invention, to have the device of Nagahama, Emerson, and Yamada utilizing the second n-type electrode contact layer of Lee because the first and second n-type electrodes with p-type layers between form an n-p-n arrangement which reduces the resistance of the device, thereby improving its efficiency. (See column 5, lines 1-9.)

With respect to claim 11, Nagahama, Yamada, Emerson, and Lee teach the device as stated above. Nagahama teaches that an n-type (first) electrode contact layer comprises a super lattice structure (see column 4, lines 24-29). Lee teaches that the second electrode contact is of n-

type as stated above. Finally, Emerson teaches the specific use of $In_xGa_{1-x}N/In_yGa_{1-y}N$ as a super lattice structure as stated above.

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of invention, to have the combined device of Nagahama, Yamada, Emerson, and Lee having the second electrode contact layer comprising a $In_xGa_{1-x}N/In_yGa_{1-y}N$ super lattice structure for the obvious reasons stated above and also because the resistance of the device can be lowered thereby decreasing the voltage and current threshold of the device. (See column 4, lines 24-29 of Nagahama 6,849,864.)

3. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nagahama (US Patent No. 6,849,864), Yamada (US Patent No. 6,608,330) and Emerson (US Patent No. 6,958,497) as applied to claim 1 above, and further in view of Tanizawa (US Patent No. 6,657,234).

Nagahama, Yamada, and Emerson do not specifically teach that the buffer layer comprises one selected from the group consisting of an InGaN/GaN super lattice structure, an $In_xGa_{1-x}N/GaN$ structure and an $Al_xIn_yGa_{1-x,y}N/In_xGa_{1-x}N/GaN$ structure. Although Nagahama does teach, from column 3, lines 60-65, that, "it is it is preferable that at least one of the first and second buffer layers is a super lattice layer made by laminating nitride semiconductor layers of different constitutions."

Nevertheless, Tanizawa, drawn to nitride based semiconductor devices, does teach, from column 3, lines 56-62, a buffer layer comprises a superlattice structure that is formed by alternately stacking $In_zGa_{1-z}N/GaN$.

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of invention, to have the device of Nagahama, Emerson, and Yamada utilizing the $In_zGa_{1-z}N/GaN$ superlattice structure in the buffer layer because these are well known materials capable of functioning as a superlattice that increases the crystallinity of the buffer layer and layers grown thereon, thereby improving device performance. (See Edmond, column 15, lines 1-15 of US Patent No. 6,906,352)

Furthermore, examiner takes the position that the material selected for the super lattice structure in the buffer layer, in view of those used in the prior art, is non-critical to the applicant's invention. Nagahama (with Yamada and Emerson) discloses all the limitations of the claimed invention except for specifically teaching that the buffer super lattice structure layer is, "an $In_xGa_{1-x}N/In_yGa_{1-y}N$ super lattice structure layer." It would have been obvious to one of ordinary skill in the art, at the time of invention, to have the buffer super lattice structure layer of Nagahama's device made of $In_xGa_{1-x}N/GaN$ (as disclosed above by Tanizawa), $Al_xIn_yGa_{1-x,y}N/In_xGa_{1-x}N/GaN$, or InGaN/GaN alternating layers, since it has been held to be within the general skill of a person in the art to select a known material on the basis of its suitability for the intended use (to enhance device crystal structure by reducing crystal defects) as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416. Note that Suzuki (US Patent No. 6,479,836), from column 11, lines 64-67 and Zheng (Non-patent document ref. [U]), from introduction, are cited for the non-criticality and well known use of this particular material structure.

4. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nagahama (US Patent No. 6,849,864), Yamada (US Patent No. 6,608,330) and Emerson (US Patent No. 6,958,497) as applied to claim 1 above, and further in view of Koike (US Patent No. 6,830,948).

Nagahama, Yamada, and Emerson do not specifically teach that the first electrode contact layer comprises a Si/In-codoped GaN layer.

Koike teaches, from fig. 2, a first electrode contact layer comprising a Si/In-codoped GaN layer (103). Layer 103 is an underlying layer which encompasses a GaN layer and silicon doped n-GaN (see column 11, lines 50-55). From column 16, lines 1-3, Koike teaches that this underlying layer may be doped with indium as well.

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of invention, to have the device of Nagahama, Emerson, and Yamada featuring a Si/In-codoped GaN electrode contact layer as described by Koike because indium doping in this underlying layer is done, "in order to improve crystallinity of the underlying layer. Improving crystallinity of the underlying layer results in further improving crystallinity of a layer growing thereon by lateral growth." (See column 16, lines 1-3.)

5. Claims 6, 9 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nagahama (US Patent No. 6,849,864), Yamada (US Patent No. 6,608,330) and Emerson (US Patent No. 6,958,497) as applied to claim 1 above, and further in view of Sverdlov (US Patent No. 6,266,355).

Nagahama, Emerson, and Yamada do not teach the device wherein the quantum well structure includes a low mole In-doped $In_xGa_{1-x}N$ layer, an $In_yGa_{1-y}N$ well layer and an $In_zGa_{1-z}N$ barrier layer.

However, Sverdlov, drawn to group III-V nitride based semiconductor devices, does teach a quantum well structure that includes a low mole In-doped (x=0.03-0.15) $In_xGa_{1-x}N$ layer (18), an $In_yGa_{1-y}N$ well layer (20) and an $In_zGa_{1-z}N$ barrier layer (22). (See column 4, lines 9-21)

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of invention, to have the device of Nagahama, Emerson, and Yamada utilizing the low mole In-doped $In_xGa_{1-x}N/In_yGa_{1-y}N$(well)/$In_zGa_{1-z}N$(barrier) layered structure because this arrangement can exclude the high temperature (900-1200°C) formation requirement of AlGaN layers thereby also avoiding crystal defects in the active region originating when heated at the higher formation temperatures. (See Background of the Invention columns 1 and 2.)

With respect to claims 9 and 10, note that a "product by process" claim is directed to the product per se, no matter how actually made. See In re Thorpe et al., 227 USPQ 964 (CAFC, 1985) and the related case law cited therein which makes it clear that it is the final product per se which must be determined in a "product by process" claim, and not the patentability of the process, and that, as here (see Keller non-patent document ref. [V]), an old or obvious product produced by a new method is not patentable as a product, whether claimed in "product by process" claims or not. As stated in Thorpe,

> Even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. In re Brown, 459 F.2d 531, 535, 173 USPQ 685, 688 (CCPA 1972); In re Pilkington, 411 F.2d 1345, 1348, 162

USPQ 145, 147 (CCPA 1969); Buono v. Yankee Maid Dress Corp., 77 F.2d 274, 279, 26 USPQ 57, 61 (2d.Cir. 1935).

Note that applicant has burden of proof in such cases as the above case law makes clear.

Claims 9 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nagahama (US Patent No. 6,849,864), Yamada (US Patent No. 6,608,330), Emerson (US Patent No. 6,958,497) and Sverdlov (US Patent No. 6,266,355) as applied to claim 6 above.

As to the grounds of the rejection under section 103(a), the method for growing the low mole In-doped $In_xGa_{1-x}N$ layer consisting of a "spiral mode" technique is an intermediate process step that holds no patentability on the structure of the final device.

6. Claims 13, 15, 19, and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nagahama (US Patent No. 6,849,864) in view of Koike (US Patent No. 6,830,948).

With respect to claim 13, Nagahama teaches, from fig. 9 (and columns 34-40), the nitride based 3-5 group compound semiconductor light emitting device comprising:

a substrate (301);

a buffer layer (304) formed above the substrate (301);

a first In doped GaN layer (312) formed above the buffer layer (304);

a first electrode contact layer (311) formed ***below*** the first In doped GaN layer (312);

an active layer (315) formed above the first electrode contact layer (311) and functioning to emit light;

a GaN layer (317 or GaN layer within superlattice 318) formed above the active layer (315); and

a second electrode contact layer (319) formed above the GaN layer (317).

Nagahama does not teach that a first electrode contact layer (311) is formed ***above*** the first In doped GaN layer (312).

However, Koike, drawn to group III-nitride light emitting diodes (LEDs), teaches, from fig. 7, underlying GaN layers (503) being doped with indium (see column 16, lines 1-5) and having a (n-type) contact layer (32) formed in and on (see fig. 1e) the In-doped GaN layer (31).

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of invention, to create the device of Nagahama utilizing the arrangement whereby the first contact layer (311) would be above the first In doped GaN layer (312) as described by Koike because not only does this result in the improved crystallinity of the GaN layers but also improves the crystallinity of any layer grown thereon, reducing defects in the device thereby resulting in better overall device efficiency and performance. (See column 16, lines 1-5.)

With respect to claim 15, as best understood by examiner, Nagahama teaches from fig. 9, the device further comprising a second In-doped GaN layer (317) formed between the active layer (315) and the GaN layer (GaN layer within superlattice 318).

With respect to claim 19, Koike teaches, from figs. 1E and 9 and column 16, lines 1-5, the device wherein the first electrode contact layer (603) comprises a Si/In-codoped GaN layer.

With respect to claim 20, Koike teaches the device wherein the active layer comprises a single or multiple quantum well structure. (See column 10, lines 33-35.)

7. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nagahama (US Patent No. 6,849,864) and Koike (US Patent No. 6,830,948), as applied to claim 13 above, and further in view of Lee (US Patent No. 6,720,570).

Nagahama and Koike do not teach that the second electrode contact layer is an n-type electrode contact layer.

However, Lee, drawn to gallium nitride LEDs, does teach, from fig. 2, a second electrode contact layer (209) that is an n-type electrode contact layer. Additionally there is p-type layers, 205, 206, and 211, placed above the first n-type electrode.

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of invention, to have the device of Nagahama and Koike utilizing the second n-type electrode contact layer of Lee because the first and second n-type electrodes with p-type layers between form an n-p-n arrangement which reduces the resistance of the device, thereby improving its efficiency. (See column 5, lines 1-9.)

8. Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nagahama (US Patent No. 6,849,864), Koike (US Patent No. 6,830,948), and Lee (US Patent No. 6,720,570) as applied to claim 13 above, and further in view of Emerson (US Patent No. 6,958,497).

Nagahama, Koike, and Lee teach the device as stated above. Nagahama teaches that an n-type (first) electrode contact layer comprises a super lattice structure (see column 4, lines 24-29). Lee teaches that the second electrode contact is of n-type as stated above.

However, Emerson, drawn to group III-nitride light emitting diodes (LEDs), teaches, from fig. 1, a $In_xGa_{1-x}N/In_yGa_{1-y}N$ super lattice structure layer (16) beneath the active region (18). (See column 7, lines 19-22.)

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of invention, to have the combined device of Nagahama, Koike, and Lee having the second electrode contact layer comprising Emerson's $In_xGa_{1-x}N/In_yGa_{1-y}N$ super lattice structure since this is a known material capable of forming a super lattice structure and also because the resistance of the device can be lowered thereby decreasing the voltage and current threshold of the device. (See column 4, lines 24-29 of Nagahama 6,849,864.)

Furthermore, examiner takes the position that the material selected for the super lattice structure, in view of those used in the prior art, is non-critical to the applicant's invention. Nagahama (with Koike and Lee) discloses all the limitations of the claimed invention except for specifically teaching that the super lattice structure layer is, "an $In_xGa_{1-x}N/In_yGa_{1-y}N$ super lattice structure layer." It would have been obvious to one of ordinary skill in the art, at the time of invention, to replace the $Al_xGa_{1-x}N/GaN$ super lattice structure layer of Nagahama, Koike, and Lee's device with one that is made of $In_xGa_{1-x}N/In_yGa_{1-y}N$ alternating layer (as disclosed above by Emerson), since it has been held to be within the general skill of a person in the art to select a known material on the basis of its suitability for the intended use (to enhance device crystal structure by reducing crystal defects) as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416. Note that Suzuki (US Patent No. 6,479,836), from column 11, lines 64-67 and Zheng (Non-patent document ref. [U]), from introduction, are cited for the non-criticality and well

known use of this particular material structure.

9. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nagahama (US Patent No. 6,849,864) and Koike (US Patent No. 6,830,948), as applied to claim 13 above, and further in view of Tanizawa (US Patent No. 6,657,234).

Nagahama and Koike do not specifically teach that the buffer layer comprises one selected from the group consisting of an InGaN/GaN super lattice structure, an $In_xGa_{1-x}N/GaN$ structure and an $Al_xIn_yGa_{1-x,y}N/In_xGa_{1-x}N/GaN$ structure. Although Nagahama does teach, from column 3, lines 60-65, that, "it is it is preferable that at least one of the first and second buffer layers is a super lattice layer made by laminating nitride semiconductor layers of different constitutions."

Nevertheless, Tanizawa, drawn to nitride based semiconductor devices, does teach, from column 3, lines 56-62, a buffer layer comprises a superlattice structure that is formed by alternately stacking $In_zGa_{1-z}N/GaN$.

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of invention, to have the device of Nagahama and Koike utilizing the $In_zGa_{1-z}N/GaN$ superlattice structure in the buffer layer because these are well known materials capable of functioning as a superlattice that increases the crystallinity of the buffer layer and layers grown thereon, thereby improving device performance. (See Edmond, column 15, lines 1-15 of US Patent No. 6,906,352)

Furthermore, examiner takes the position that the material selected for the super lattice structure in the buffer layer, in view of those used in the prior art, is non-critical to the

applicant's invention. Nagahama (with Koike) discloses all the limitations of the claimed invention except for specifically teaching that the buffer super lattice structure layer is, "an $In_xGa_{1-x}N/In_yGa_{1-y}N$ super lattice structure layer." It would have been obvious to one of ordinary skill in the art, at the time of invention, to have the buffer super lattice structure layer of Nagahama's device made of $In_xGa_{1-x}N/GaN$ (as disclosed above by Tanizawa), $Al_xIn_yGa_{1-x,y}N/In_xGa_{1-x}N/GaN$, or InGaN/GaN alternating layers, since it has been held to be within the general skill of a person in the art to select a known material on the basis of its suitability for the intended use (to enhance device crystal structure by reducing crystal defects) as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416. Note that Suzuki (US Patent No. 6,479,836), from column 11, lines 64-67 and Zheng (Non-patent document ref. [U]), from introduction, are cited for the non-criticality and well known use of this particular material structure.

10. Claims 21, 24 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nagahama (US Patent No. 6,849,864) and Koike (US Patent No. 6,830,948), as applied to claim 13 above, and further in view of Sverdlov (US Patent No. 6,266,355).

Nagahama and Koike do not teach the device wherein the quantum well structure includes a low mole In-doped $In_xGa_{1-x}N$ layer, an $In_yGa_{1-y}N$ well layer and an $In_zGa_{1-z}N$ barrier layer.

However, Sverdlov, drawn to group III-V nitride based semiconductor devices, does teach a quantum well structure that includes a low mole In-doped (x=0.03-0.15) $In_xGa_{1-x}N$ layer (18), an $In_yGa_{1-y}N$ well layer (20) and an $In_zGa_{1-z}N$ barrier layer (22). (See column 4, lines 9-21)

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of invention, to have the device of Nagahama, Emerson, and Yamada utilizing the low mole In-doped $In_xGa_{1-x}N/In_yGa_{1-y}N$(well)/$In_zGa_{1-z}N$(barrier) layered structure because this arrangement can exclude the high temperature (900-1200°C) formation requirement of AlGaN layers thereby also avoiding crystal defects in the active region originating when heated at the higher formation temperatures. (See Background of the Invention columns 1 and 2.)

With respect to claims 24 and 25, note that a "product by process" claim is directed to the product per se, no matter how actually made. See In re Thorpe et al., 227 USPQ 964 (CAFC, 1985) and the related case law cited therein which makes it clear that it is the final product per se which must be determined in a "product by process" claim, and not the patentability of the process, and that, as here (see Keller non-patent document ref. [V]), an old or obvious product produced by a new method is not patentable as a product, whether claimed in "product by process" claims or not. As stated in Thorpe,

> Even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. In re Brown, 459 F.2d 531, 535, 173 USPQ 685, 688 (CCPA 1972); In re Pilkington, 411 F.2d 1345, 1348, 162 USPQ 145, 147 (CCPA 1969); Buono v. Yankee Maid Dress Corp., 77 F.2d 274, 279, 26 USPQ 57, 61 (2d.Cir. 1935).

Note that applicant has burden of proof in such cases as the above case law makes clear.

Claims 24 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nagahama (US Patent No. 6,849,864), Koike (US Patent No. 6,830,948), and Sverdlov (US Patent No. 6,266,355) as applied to claim 21 above.

As to the grounds of the rejection under section 103(a), the method for growing the low mole In-doped $In_xGa_{1-x}N$ layer consisting of a "spiral mode" technique is an intermediate process step that holds no patentability on the structure of the final device.

11. Claims 34, 38 and 39 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nagahama (US Patent No. 6,849,864) in view of Sverdlov (US Patent No. 6,266,355).

With respect to claim 34, Nagahama teaches, from fig. 9 (and columns 34-40), the nitride based 3-5 group compound semiconductor light emitting device comprising:

a substrate (301);

a buffer layer (304) formed above the substrate (301);

a first electrode contact layer (311) formed above the GaN buffer layer (304);

an active layer (315) formed above the first electrode contact layer (311),

a GaN layer (317) formed above the active layer (315); and

a second electrode contact layer (319) formed above the GaN layer (317).

Nagahama does not teach the device wherein the quantum well structure includes a low mole In-doped $In_xGa_{1-x}N$ layer, an $In_yGa_{1-y}N$ well layer and an $In_zGa_{1-z}N$ barrier layer.

However, Sverdlov, drawn to group III-V nitride based semiconductor devices, does teach a quantum well structure that includes a low mole In-doped (x=0.03-0.15) $In_xGa_{1-x}N$ layer (18), an $In_yGa_{1-y}N$ well layer (20) and an $In_zGa_{1-z}N$ barrier layer (22). (See column 4, lines 9-21)

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of invention, to have the device of Nagahama utilizing the low mole In-doped $In_xGa_{1-x}N/In_yGa_{1-y}N$(well)/$In_zGa_{1-z}N$(barrier) layered structure of Sverdlov because this arrangement can exclude

the high temperature (900-1200°C) formation requirement of AlGaN layers thereby also avoiding crystal defects in the active region originating when heated at the higher formation temperatures. (See Background of the Invention columns 1 and 2.)

With respect to claims 38 and 39, note that a "product by process" claim is directed to the product per se, no matter how actually made. See In re Thorpe et al., 227 USPQ 964 (CAFC, 1985) and the related case law cited therein which makes it clear that it is the final product per se which must be determined in a "product by process" claim, and not the patentability of the process, and that, as here (see Keller non-patent document ref. [V]), an old or obvious product produced by a new method is not patentable as a product, whether claimed in "product by process" claims or not. As stated in Thorpe,

> Even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. In re Brown, 459 F.2d 531, 535, 173 USPQ 685, 688 (CCPA 1972); In re Pilkington, 411 F.2d 1345, 1348, 162 USPQ 145, 147 (CCPA 1969); Buono v. Yankee Maid Dress Corp., 77 F.2d 274, 279, 26 USPQ 57, 61 (2d.Cir. 1935).

Note that applicant has burden of proof in such cases as the above case law makes clear.

Claims 38 and 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nagahama (US Patent No. 6,849,864), Koike (US Patent No. 6,830,948), and Sverdlov (US Patent No. 6,266,355) as applied to claim 21 above.

As to the grounds of the rejection under section 103(a), the method for growing the low mole In-doped $In_xGa_{1-x}N$ layer consisting of a "spiral mode" technique is an intermediate process step that holds no patentability on the structure of the final device.

12. Claim 35 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nagahama (US Patent No. 6,849,864) and Sverdlov (US Patent No. 6,266,355) as applied to claim 34 above, and further in view of Lee (US Patent No. 6,720,570).

Nagahama and Sverdlov do not teach that the second electrode contact layer is an n-type electrode contact layer.

However, Lee, drawn to gallium nitride LEDs, does teach, from fig. 2, a second electrode contact layer (209) that is an n-type electrode contact layer. Additionally there is p-type layers, 205, 206, and 211, placed above the first n-type electrode.

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of invention, to have the device of Nagahama and Sverdlov utilizing the second n-type electrode contact layer of Lee because the first and second n-type electrodes with p-type layers between form an n-p-n arrangement which reduces the resistance of the device, thereby improving its efficiency. (See column 5, lines 1-9.)

Allowable Subject Matter

13. Claims 7, 8, 16, 17, 22, 23, 36, and 37 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

14. The following is a statement of reasons for the indication of allowable subject matter:

With respect to claims 7, 22, and 36, all claims containing similar subject matter, the prior record of art fails to show a three layered quantum well structure - low mole In-doped

$In_xGa_{1-x}N$ layer/ $In_yGa_{1-y}N$ well layer / $In_zGa_{1-z}N$ barrier layer – wherein the low mole In-doped $In_xGa_{1-x}N$ layer has an In content smaller than that of the $In_zGa_{1-z}N$ barrier layer.

With respect to claims 8, 23, and 37, all claims containing similar subject matter, the prior record of art fails to show a three layered quantum well structure - low mole In-doped $In_xGa_{1-x}N$ layer/ $In_yGa_{1-y}N$ well layer / $In_zGa_{1-z}N$ barrier layer – wherein the low mole In-doped $In_xGa_{1-x}N$ layer, the $In_yGa_{1-y}N$ well layer and the $In_zGa_{1-z}N$ barrier layer have an In content expressed as $0<x<0.05$, $0<y<0.3$ and $0<z<0.1$, respectively.

With respect to claim 16, the prior record of art fails to show a first electrode contact layer above a first In-doped GaN wherein a $In_xGa_{1-x}N/In_yGa_{1-y}N$ super lattice structure layer is also formed between the first In-doped GaN layer and the first electrode contact layer.

With respect to claim 17, the prior record of art fails to show a first electrode contact layer above a first In-doped GaN wherein an $In_xGa_{1-x}N/In_yGa_{1-y}N$ super lattice structure and an undoped GaN layer is formed between the first In-doped GaN layer and the first electrode contact layer.

15. Claim 12 would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112, 2nd paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter: The prior record of art fails to show a buffer layer formed above the substrate; a first In doped GaN layer formed above the buffer layer; a $In_xGa_{1-x}N/In_yGa_{1-y}N$ super lattice structure layer formed above the first In-doped GaN layer; and a first electrode contact layer formed above the

$In_xGa_{1-x}N/In_yGa_{1-y}N$ super lattice structure layer; wherein the first In-doped GaN layer and the $In_xGa_{1-x}N/In_yGa_{1-y}N$ super lattice structure layer formed thereon are repeatedly layered in plurality.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brian Kunzer whose telephone number is (571) 272-5054. The examiner can normally be reached on Monday-Friday 8:00-4:30 EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (571) 272-1705. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

BK
12/8/2005

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PRIMARY EXAMINER